New Mexico Space Grant Consortium
Lead Institution: New Mexico State University
Director: Patricia Hynes
Telephone Number: 575-646-6414
Consortium URL: nmspacegrant.com
Grant Number: NNXI0AM48H

PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The New Mexico Space Grant Consortium is a Designated Consortium funded at a level of $575,000 for fiscal year 2013.

PROGRAM GOALS

Consortium Goals and SMART Objectives from your 2010 base proposal and budget (or as amended in subsequent submissions)

Goal: Education: Take advantage of our unique geographic position and proximity to Spaceport America to provide a link to commercial launch opportunities for students and faculty.
Objective: Use various NMSGC programs to focus students and faculty in NASAs opportunities

Goal: Marketing: Communicate unique NMSGC programs to local, state, and national leaders in STEM education and research.
Objective: Present to local and national audiences at conferences and meetings. Increase followers for NMSGC programs on social media platforms

Goal: Business: Enable commercial space industry development by highlighting NASA & NMSGC programs and capabilities.
Objective: Continue student launch program partnership with UP Aerospace. Convene the International Symposium for Personal Spaceflight (ISPCS)

Goal: NMSGC will be a clearing house for statewide space related expertise, information, facilities, and education.

Objective: Increase capstone projects which will include applying to NASA Announcements of Opportunity.

Goal: Collaboration: Increase our collaboration with STEM education partners.
Objective: Create ongoing relationships with industry and community organizations

PROGRAM/PROJECT BENEFIT TO OUTCOME (1, 2, & 3)

Provide concise, meaningful highlights or anecdotes (no more than three) that are directly related to work completed in 2013, highlighting student and/or project accomplishments. Specify alignment to an Outcome.

Outcome 1:
"The Living Learning Community program has allowed me to access actual projects within the Mechanical Engineering Department that as a Freshman I don't feel I would be able to. The shock of changing into the college life is a big one and is glamorized by people before coming to college.
It was because of this that I thought that I would immediately jump into mechanical engineering type teaching. Instead I have had to spend freshman year taking all of the prerequisites courses. It is only thanks to this course I have been able to work and learn Mechanical Engineering Information from the start of freshman year. I would recommend this course to any new freshman mechanical student." Gabriel Montoya, Mechanical Engineer Major, NM Tech student

Outcome 2:
"They created an experiment involving algae, yeast and "desert shrimp," a tiny organism that emerges from desert ground after a rainstorm. I think it made a big difference about how they viewed science, as a possible career." Scott Chaapel, Science Teacher, Camino Real Middle School

Outcome 3:
"Attending ISPCS in October of 2013 allowed me to experience and participate in the exchange of ideas among the top leaders in the private spaceflight industry. As I listened to the talks given about the future of space law, safety in space, and the advances of companies like SpaceX and CASIS, I formulated my own ideas about how I can help this industry reach its potential in the future. During the breaks and meals throughout the conference, I was able to learn about what opportunities there are for me to participate in the formation of the "new space" industry. Meeting and talking with people from such organizations at United Launch Alliance, Waypoint 2 Space, and International Space University helped me get a feel for what qualities are important in an employee of a space company, which has helped me focus my priorities as I work to finish my Master's Degree and enter the industry within the coming year." Suzi Gordon, Earth and Planetary Science Major, University of New Mexico student

PROGRAM ACCOMPLISHMENTS

Refer directly to the consortium goals and SMART objectives in your 2010 base proposal when describing your accomplishments.

Outcome 1: *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals:* (Discussion of achievements and progress related to your Fellowship/Scholarship, Higher Education and Research Infrastructure programs). *(Employ and Educate)*

Fellowship/Scholarship

SMART OBJECTIVES:

- Retain & graduate 90% of NMSGC scholars of whom 54.9% will be minority students; 40% will be females
- Require all NMSGC scholars to perform NASA related research with faculty, present their research annually during the Student Colloquium and perform 10 hours community service
- Increase the number of students who apply for scholarships/fellowships
- Retain & graduate 90% of NASA Internships of whom 54.9% will be minority students; 40% will be females
- Track 100% of selected interns to determine their persistence in STEM through to graduation

ACCOMPLISHMENTS:

- Retain & Graduate NMSGC Scholars
    - 100% of NMSGC scholars were retained & graduated
    - 43% are females
- Require all NMSGC scholars to perform NASA related research with faculty, present their research annually during the Student Colloquium and perform 10 hours community service
    - 100% of students performed NASA related research with faculty
    - 100% of NMSU students presented their research during Student Colloquium
    - 100% of students performed 10 hours of community service
- Increase the number of students who apply for scholarships/fellowships
    - 130 students applied for scholarships/fellowships compared to 86 in the previous year
- Retain & Graduate NASA Internships
    - We cannot report on minority status or females because NASA Internships have not been selected yet this year
- Track NASA Internships
    - 100% of NASA Interns persisted in STEM through to graduation

Higher Education

SMART OBJECTIVE:

- Recruit NMSGC students to design, build and/or fly experiments into space

- Involve faculty & students in curriculum development that supports NASA's 4 Mission Directorates & OCT
- Partner with colleges at research universities to influence curriculum to contain space themes
- Partner with NMSU and New Mexico Institute of Mining and Technology to create two Freshman Experience classes with space content

ACCOMPLISHMENTS:

- Recruit NMSGC students to design, build and fly experiments into space
    - Dr. Ou Ma, Mechanical Engineering, NMSU was supported to design Hands on Aerospace Training
        - 10 students participated
        - Description: Provided a hands-on design opportunity for students, which was aimed at developing an autonomous suborbital flight experiment. This experiment was tested during November 2013 launch, supported by Flight Opportunities.
- Involve faculty & students in curriculum development that supports NASA's 4 Mission Directorates & OCT
    - Dr. Hongmei Luo, Chemical Engineering, NMSU and Dr. Peter Cooke, Chemical Engineering, NMSU were funded to develop the curriculum Fulfilling Laboratory Essentials in a Nanoscience and Nanotechnology Training Course
        - 20 students participated
        - Description: The goals of this project are to effectively integrate nanoscience and nanotechnology into the undergraduate engineering curriculum, and to fulfill laboratory essentials to the ChE 467 course. The objectives are to: develop nanotechnology modules for college-wide freshman and sophomore classes; fulfill a laboratory component to develop student skills with nanotechnology tools; and increase the number of undergraduate students participating in research, especially women and minority students
- Partner with colleges at research universities to influence curriculum to contain space themes
    - Dr. Gabe Garcia, Professor, Mechanical Engineering, NMSU was supported to design the curriculum for Magellan – Senior Capstone.
        - 5 students participated
        - Description: Constructed a full 3D model of the robotic model Dragon in NX 8. Using this model we have been able to simulate the desired motion (movements) of the Dragon as well as the mechanisms that would be needed to generate the motion. Currently we are in the process of fine tuning the designs of the various mechanisms and hope to begin construction of the mechanisms soon.

Scaled models of the Dragon have been completed. These models have been used to help with the construction of the NX model as well as help with the understanding of the motion of the dragon. All the conceptual work has been completed for the design of the dragon. The preliminary design work has been completed for this task, it is just a matter of finalizing the design which cannot be done until the full scale model is built. Once a full scaled foam model is constructed and coated with fiberglass or other type of epoxy then they will build, attach and implement the mechanisms to complete the Dragon.

- Dr. Steve Stochaj, Electrical Engineer, NMSU was supported to design the curriculum NMSU Ground Satellite Station– Senior Capstone Design
  - 5 students participated
  - Description: Goal is to create a satellite ground station located on the NMSU campus that will allow University built LEO satellites to have a fully functioning local operating ground station. This project was completed in December 2013.

- Partner with NMSU and New Mexico Institute of Mining and Technology to create two Freshman Experience classes with space content
  - Dr. Warren J. Ostergren, Associate Professor and Chair, Mechanical Engineering, NM Tech was supported to create the class Freshman Experience at New Mexico Tech-Enhancing the Living.
    - 22 students participated
    - Description: The objective of this class is to enrich the freshman and sophomore year mechanical engineering experiences through an earlier focus on research and design projects for students. This objective is in part guided by the recommendation put forth in the National Academy of Engineering's Engineer of 2020 report that the "iterative process of designing, predicting performance, building and testing…be taught from the earliest stages of the curriculum, including the first year" (p.33). The expected outcome will be students who are more enthused and successful in their chosen field and who are more prepared for the academic challenges facing them in the junior and senior years. This project will enhance the freshman experience by building upon development of a new Living Learning Community (LLC) for Mechanical Engineering students at New Mexico Tech
  - Dr. Sonya Cooper, Associate Dean, NMSU is being funded to support the NMSU Freshman Experience Cohort. They are currently in the design phases of the class and will start teaching Spring 2015. This class will involve the design of space hardware as one section of the freshman experience.

- Additional Supported Projects included:
    - Dr. Young Lee, Mechanical Engineering, NMSU was supported for the Student Competition - Design, Build, Fly AIAA Rocket competition
        - 36 students participated
        - Description: For the past three years our student team has participated in the Cessna Aircraft Company/Raytheon Missile Systems -Student Design/Build/Fly Competition. The contest provides a real-world aircraft design experience for engineering students by giving them the opportunity to validate their analytic studies. This year's competition is modeled after the recent Joint Strike Fighter development. In the three missions required at the competition in April we had to demonstrate our aircraft's ability to take off in a short distance and fly with an empty payload, full internal payload, and one of the random six different configurations of internal and externally mounted payload. The goal is a balanced design possessing good flight handling qualities and practical and affordable manufacturing all while providing a high flight performance. To encourage innovation and maintain a fresh design challenge for each new year, the design requirements and performance objectives will be updated for each new contest year. The changes will provide new design requirements and opportunities, while allowing for application of technology developed by the teams from prior years. Throughout the year students must also document all engineering decisions in an all-encompassing report that is a heavy part of the scoring system at the competition.
    - Dr. Patricia Sullivan, Assistant Dean, NMSU partnered with NMSGC to support the BEST Program.
        - 23 students participated
        - Description: NMSU engineering students serve as mentors to the middle school and high school students who are designing and building functional robots.
    - Dr. Ricardo B. Jacquez, Dean, College of Engineering, NMSU partnered with NMSGC to support the New Mexico AMP Student Research Conference
        - 128 students participated
        - Description: The New Mexico Alliance for Minority Participation hosted its annual statewide student research conference on the campus of NMSU. The conference brought together students and faculty from the state’s colleges and universities as well as students and teachers from the New Mexico Math, Engineering, Science Achievement, Inc. (New Mexico MESA) program. NMSGC set up a table in their exhibit area to educate students about the opportunities that NMSGC offers.
    - Dr. Patricia Hynes, Director, NMSGC partnered with the ISPCS
        - 10 students participated

        - Description: ISPCS is to grow the commercial space industry. Showcase new technologies driving the commercial space industry including: new launch facilities, commercially developed launch vehicles, and support/showcase NASA COTS, CCiCAP, FOP, and CASIS Programs. ISPCS and NMSGC are partners in this event.
    - Dr. Patricia Hynes, Director, NMSGC supported the Annual NMSGC Student Colloquium
        - 8 students participated
        - Description: A requirement of the NMSU scholarship recipients is to present their research results at the annual colloquium
    - Dr. Andrew Godsil, Mechanical Engineering, NM Tech was supported for the Student Competition Intercollegiate Rocket Engineering Competition
        - 7 students participated
        - Description: Since the spring 2013 semester began, the team has been heavily engaged in the construction of its competition rocket, SCEPTER (Scientific Cargo and Experimental Payload Transportation and Exploration Rocket). Much of the construction is finished and the team looks forward to completing the rocket by mid-March. In addition to a test flight of SCEPTER in April, the team will continue testing to verify components, simulations, and continue to prepare for the competition.

Research Infrastructure

SMART OBJECTIVE:

- Engage faculty & students in research related to NASA's 4 Mission Directorates & OCT
- All funded research will answer big questions posed by the directorates &/or align with strategies to strengthen NASA's ability to meet the challenges of the Agency

ACCOMPLISHMENTS:

- Engage faculty & students in research related to NASA's 4 Mission Directorates & OCT
    - 100% of funded faculty & students were involved in research related to NASA's 4 Mission Directorates & OCT
- 100% of funded research was focused on answering a big question posed by the directorates &/or align with strategies to strengthen NASA's ability to meet the challenges of the Agency
    - Supported Projects included
        - Dr. Chris Churchill, Astronomy, NMSU was supported to research the Direct Confrontations with Galaxy Evolution Theory
            - 2 student participants
            - Description: Directly test modern galaxy evolution theory by using real-world observations that they quantitatively compare to observations predicted by theory. They do this by performing the identical "observational" experiment in high-powered cosmological simulations of galaxy formation as they do with the real data.

- Dr. Igor Sevostianov, Mechanical Engineering, NMSU, was supported to research the Modeling Conductivities in Assembling Battery Terminals
    - 1 student participant
    - Description: A seed project aimed to develop a theoretical background for the contact resistance (both thermal and electrical) across multi-layer bi-metal joint used in battery terminals from known engineering measurement data and material properties of the alloys used.

Outcome 2: *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty:* (Discussion of achievements primarily focused on your Higher Education programs not discussed in Outcome 1 and your Precollege programs). *(Educate and Engage)*

SMART OBJECTIVE:

- Partner with the Las Cruces Public School district's 7 middle schools to integrate a space project into their new science curriculum.
- Create 1 experiment and launch it either on a balloon or rocket.
- Partner with Galactic Unite organization
- Partner with Summer programs to enrich science curriculum

ACCOMPLISHMENTS:

- Partner with the Las Cruces Public School District
    - Las Cruces Pubic School District has not been responsive to the many discussions/meetings we have had with them regarding the integration of a space project into the new science curriculum. We are developing a relationship with 12 different public schools (Tatum, Lovington, Eunice, Jal, Carlsbad, Hagerman, Dexter, Artesia, Hobbs, Loving, Lake Arthur, and Roswell) in the Eastern part of New Mexico in hopes of involving them in the Student Launch Program.
- Create 1 experiment and launch it either on a balloon or rocket
    - We are developing a relationship with 12 different public schools (Tatum, Lovington, Eunice, Jal, Carlsbad, Hagerman, Dexter, Artesia, Hobbs, Loving, Lake Arthur, and Roswell) in the Eastern part of New Mexico in hopes of involving them in the Student Launch Program.
- Partner with Galactic Unite Philanthropy
    - Dr. Hynes is an active member of Galactic Unite Philanthropy Education Board. They are involved in the Student Launch Program.
- Partner with Summer Programs
    - Continue and grow the middle school partnerships in the Student LaunchProgram.

Outcome 3: *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's*

mission: (Achievements and progress of Informal Education programs). *(Engage and Inspire)*

SMART OBJECTIVE:

- Use existing programs in museums & science centers in NM to engage Americans in NASA's mission.
- Initiate a relationship with the Challenger Learning Center in NM
- Increase faculty and student participation at the ISPCS and its related community and education
- Become the statewide and national resource for education outreach that supports the emerging commercial space industry
- Recruit federal government leadership supporting and facilitating the evolution of commercial space transportation to speak at ISPCS

ACCOMPLISHMENTS:

- Use existing programs in museums & science centers in NM to engage Americans in NASA's mission.
- Initiate a relationship with the Challenger Learning Center in NM
- Increase faculty and student participation at ISPCS and its related community and education
    - Supported 13 faculty and students to participate in the ISPCS and its related community and education events
- Become the statewide and national resource for education outreach that supports the emerging commercial space industry
    - Developed an extensive database of all STEM department heads and faculty all institution in New Mexico that allow our office to forward announcements of opportunity to the entire state that supports the commercial space industry.
- Recruit federal government leadership supporting and facilitating the evolution of commercial space transportation to speak at ISPCS
    - Recruited federal government leaders to speak at ISPCS unfortunately due to the government shutdown they were not able to attend or participated.
        - Bill Gerstenmaier, Associate Administrator, Human Exploration and Operations, NASA
        - Jason Crusan, Director, Advanced Exploration Systems Division, NASA
        - Phil McAlister, Commercial Spaceflight Director, NASA HQ
        - LK Kubendran, Flight Opportunities Program Executive, NASA
        - George Nield, Associate Administrator Commercial Space Transportation, FAA

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Student Data and Longitudinal Tracking:** Number of program student participants employed by NASA, aerospace contractors, universities, and other educational institutions; Number of undergraduate students who move on to advanced education in NASA-related disciplines; Number of underrepresented and underserved students participating.
  (Example: Student Data and Longitudinal Tracking: Total awards= 200; Fellowship/Scholarship= 120, Higher Education/Research Infrastructure= 80; 90 of the total awards are underrepresented minority F/S funding; 10 students have accepted STEM positions in an aerospace industry, while 3 have graduated and are pursuing advanced STEM degrees.)
  - Total students tracked = 328 Scholarship awards 281; Higher education = 47
  - 40% of total awards represent under-represented minority F/S funding.
  - 61 students accepted STEM positions in an aerospace industry, NASA, or academic fields; 16 students have graduated and are pursuing advanced STEM degrees.

- **Minority-Serving Institution Collaborations:** Summarize interactions. Reference the names of projects with MSI collaborations.
  - New Mexico State University (HSI) is the lead institution for NMSGC. NMSU participates in our scholarship program, internship program, Research Enhancement Program, Education Enhancement Program, and Higher Education Programs
  - University of New Mexico (HSI) participates in NMSGC scholarship program, internship program, and Research Enhancement Program
  - New Mexico Institute of Mining and Technology (HSI) participates in our scholarship program, internship program, Research Enhancement Program, Education Enhancement Program, and Higher Education Program
  - Southwest Indian Polytechnic Institute (Tribal College) participates in our scholarship program

- **NASA Education Priorities:** *Accomplishments related to the "Current Areas of Emphasis" stated in the 2010 Space Grant solicitation. Report on areas that apply to work proposed in your proposal and budget.*

  - Authentic, hands-on student experiences in science and engineering disciplines – the incorporation of active participation by students in hands-on learning or practice with experiences rooted in NASA-related, STEM-focused questions and issues; the incorporation of real-life problem-solving and needs as the context for activities.
    - NMSGC Fellowship/Scholarship Program
    - NASA Internship Program
    - Student Launch Program

- Capstone Design Courses
- Research Enhancement
- Education Enhancement

- Diversity of institutions, faculty, and student participants (gender, underrepresented, underserved).
  - Outcome 1: Fellowships/Scholarships: 40% minority and 43.33% female
  - Outcome 1: Higher Education: 71.53% minority and 40.88% female
  - Outcome 1: Research Infrastructure: 100% minority and 0% female
  - 80% Minority Serving Institutions
  - 20% Tribal Serving Institutions
- Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise. Capabilities for teachers to provide authentic, hands-on middle school student experiences in science and engineering disciplines (see above).
  - Summer of Innovation Program-we had six experiments manifested to launch on the UP Aerospace SL 7 vehicle on June 20, 2013. This flight is sponsored by NASA Flight Opportunities.
    - Schools included: DACC-Project Lead the Way, La Academia de Dolores Huerta, Cobre High School, Grants High School, Camino Real Middle School, and Legacy Christian Academy (students from SOI are not included in Outcome #2 count of participants)
  - BEST- is a program designed specifically to interested middle and high school students in the areas of engineering, science, and technology and to go on and purse careers in these areas
- Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers.
  - BEST- is a program designed specifically to interested middle and high school students in the areas of engineering, science, and technology and to go on and purse careers in these areas
- Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges.
  - We are working with DACC and SIPI to involve them in the Student Launch Program
- Aeronautics research – research in traditional aeronautics disciplines; research in areas that are appropriate to NASA's unique capabilities; directly address the fundamental research needs of the Next Generation Air Transportation System (NextGen).
  - We are doing research in collaboration with the FAA on NextGen transportation systems. We did fly the ADSB instrument on the

SL7 flight in June 2013. Faculty and students are involved in the tracking of the flight and post flight data analysis.

- Environmental Science and Global Climate Change – research and activities to better understand Earth's environments.
    - NMSGC does not currently have any projects.
- Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities.
    - Faculty are encouraged to apply for Research Enhancement and Education Enhancements grants to help focus their research on NASA priorities.

IMPROVEMENTS MADE IN THE PAST YEAR

Succinctly *describe improvements and/or adjustments made last year that demonstrate significant change(s) within the consortium. The improvements and/or adjustments that brought about change may have been in management, resource allocation, project design, project evaluation, etc.*

- Award scholarships twice a year to monitor more closely participation across the state of students in STEM disciplines, as well as women and minorities. As we noticed in 2011, a steep decline in proposed NASA related projects led to fewer awards to all students.
    - 2011- 45 applications received, 11 females applied, 9 minorities applied
    - 2012- 86 applications received, 23 females applied, 14 minorities applied
    - 2013-130 applications received, 48 females applied, 31 minorities applies
- Updated undergraduate and graduate scholarships applications to include Research priorities for each of the Mission Directorates (includes Centers) and the Office of the Chief Technologist
- Developed an extensive database of all STEM faculty at the 4 year colleges in New Mexico: New Mexico Highlands University, Eastern New Mexico, Southwest Indian Polytechnic Institute, Northern New Mexico College, Navajo Technical College and Western New Mexico College. This database is used to distribute scholarship announcements on a weekly basis when opportunity is open.
- Attended statewide Annual Alliance for Minority Participation (AMP) Conference; distributed scholarship information and had an information table during the conference
- Developed an extensive database of faculty advisors of student groups. This database is used to distribute scholarship announcements on a weekly basis when opportunity is open.
- Embarked on a collaboration with the NMSU College of Engineering and the College of Engineering at NM Tech to participate in their pilot program for recruitment and retention in freshman and sophomore engineering classes
- Met with Directors of Women's studies programs at the three research universities in New Mexico.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

List the institutions that comprise the consortium; include the name, type of institution, key characteristics, and role.

- Research Universities: New Mexico State University (HSI); University of New Mexico (HSI); New Mexico Institute of Mining & Technology (HSI)
- Comprehensive University: Eastern New Mexico (HSI); New Mexico Highlands University (HSI); Southwest Indian Polytechnic Institute (Tribal College); Northern New Mexico College (HSI); Navajo Technical College (Tribal College); Western New Mexico College (HSI)
- Partners publicize student opportunities, teach courses for the Student Launch Program Capstone program and offer higher education programs/workshops and offer educational programs through the Education Enhancement Program. Faculty also provide research programs and serve as reviewers on the Research Enhancement Program.

The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.